TABLE 27

NATURAL LOG OF PROPERTY VALUES REGRESSED ON THE CONTAMINATED ZONES AFTER INCIDENT—SAMPLES 1 AND 2 COMBINED

---------- Variables in the equation ----------

Variable	B	Std error B	F
LSZLN	0.6973578D-01	0.01687	17.096
AGE	-0.1472605D-02	0.00067	4.788
COND	-0.1835900D+00	0.03392	29.291
BMT	-0.2919569D-01	0.01465	3.972
AIR	-0.4657657D-01	0.01310	12.646
FPL	-0.5453523D-01	0.01598	11.654
BTR	0.6623288D-01	0.01625	16.621
HRELN	0.3089936D+00	0.03561	75.280
GRGB	0.6055403D-01	0.02731	4.917
GRGC	0.8786870D-01	0.02880	9.310
GRGD	0.9333826D-01	0.06465	2.085
OTBN	0.4813514D-01	0.02106	5.225
DHS	-0.2115232D+00	0.08399	6.342
DCBDLN	-0.2878946D-01	0.02106	1.869
SDA	0.1118305D+01	0.10703	109.170
SDB	0.1171968D+01	0.08757	179.117
SDC	0.1173413D+01	0.09210	162.335
SDD	0.1074670D+01	0.09500	127.963
SDE	0.1010272D+01	0.08860	130.020
SDF	0.1167010D+01	0.08997	168.243
SDG	0.1125449D+01	0.08916	159.351
SDH	0.1104702D+01	0.09986	122.379
SDI	0.1082230D+01	0.08844	149.733
SDJ	0.1109379D+01	0.08546	168.529
SDK	0.9578041D+00	0.08520	126.381
SDL	0.9277627D+00	0.08597	116.463
SDM	0.9113990D+00	0.08487	115.327
SDN	0.8634868D+00	0.08433	104.727
SDO	0.8352899D+00	0.08546	95.524
SDP	0.8143566D+00	0.09160	79.038
SDQ	0.8030353D+00	0.08636	86.470
SDR	0.7841710D+00	0.08383	87.505
SDS	0.7920638D+00	0.08721	82.481
SDT	0.7149520D+00	0.08834	65.500
SDU	0.7698777D+00	0.08499	82.052
SDV	0.7016588D+00	0.08500	68.148
SDW	0.6971377D+00	0.08843	62.155
SDX	0.7839902D+00	0.09157	73.309
SDY	0.6075761D+00	0.09737	38.938
SDZ	0.7804615D+00	0.09768	63.839
SDAA	0.7861508D+00	0.09287	71.664
SDBB	0.6668004D+00	0.10545	39.983
SDCC	0.7111285D+00	0.08903	63.805
SDDD	0.6195824D+00	0.09192	45.434
SDEE	0.6552238D+00	0.08610	57.907

SDFF	0.6379628D+00	0.09519	44.913
SDGG	0.6692235D+00	0.09173	53.226
SDHH	0.5930430D+00	0.08362	50.298
SDII	0.5580171D+00	0.08862	39.650
SDJJ	0.6074083D+00	0.08941	46.156
SDKK	0.5203221D+00	0.08977	33.596
SDLL	0.5314052D+00	0.08564	38.505
SDMM	0.4425589D+00	0.08606	26.445
SDNN	0.4121915D+00	0.08787	22.004
SDOO	0.3787504D+00	0.08456	20.062
SDPP	0.3662164D+00	0.08385	19.075
SDQQ	0.3743469D+00	0.08510	19.349
SDRR	-0.5702279D-01	0.10298	0.307
SDSS	0.3217187D+00	0.08520	14.258
SDTT	0.3063093D+00	0.08899	11.848
SDUU	0.3969844D+00	0.10997	13.033
SDVV	0.2729624D+00	0.10254	7.086
SDWW	0.2069348D+00	0.10542	3.853
SDXX	0.1268100D+00	0.10238	1.534
SDYY	0.1847167D+00	0.15605	1.401
SDZZ	0.1208369D-01	0.15558	0.006
SDAAA	0.5349192D-02	0.15716	0.001
ZNA	-0.1122299D-01	0.05195	0.047
ZNB	0.4116878D-01	0.05734	0.516
ZNE	-0.1416387D-02	0.02621	0.003
ZNF	-0.3393114D-01	0.03560	0.909
ZNJ	-0.5996178D-01	0.05394	1.236
PDEN	0.2801482D-01	0.04687	0.357
CLE	-0.4652950D+00	0.08066	33.273
CLF	-0.2965931D+00	0.05947	24.871
CLG	-0.1023078D+00	0.05548	3.400
CTZA	0.6521841D-01	0.03773	2.989
CTZB	0.2869877D-01	0.02207	1.691
PLG	0.8708589D-01	0.07047	1.527
PLV	0.8808066D-01	0.02736	10.362
DPW	0.3436083D-01	0.03800	0.818
DAC	0.4910573D-01	0.02999	2.681
(Constant)	0.9912837D+00		

Analysis of variance	Df	Sum of squares	Mean square	F
Regression	82.	122.33003	1.49183	84.80691
Residual	592.	10.41381	0.01759	

Multiple R	0.95997
R square	0.92155
Adjusted R square	0.91068
Standard error	0.13263

LIST OF PLEASANT PLAINS VARIABLES

CODE	VARIABLE	DESCRIPTION/COMMENTS
*AIR	air conditioning	yes = 0, no = 1
AGE	age of house when sold	year built - sales date
*ATT	attic	yes = 0, no = 1
BDR	bedrooms	number of bedrooms
*BMT	basement	yes = 0, no = 1
BMTC	% finished BMT	percentage of basement finished
BTR	bathroom	# of bathrooms
COND	condition	good (G) = 1, fair (F) = 2, poor (P) = 3
*CLE	classification for below average construction	yes = 1, no = 0
*CLF	classification for average construction	yes = 1, no = 0
*CLG	classification for above average construction	yes = 1, no = 0
*CLH	classification for good grade size and construction	yes = 1, no = 0
*CLI	classificiation for high grade construction	yes = 1, no = 0
*CONB	brick construction	yes = 1, no = 0
*CONF	frame construction	yes = 1, no = 0
*CONC	concrete construction	yes = 1, no = 0

*Dummy variable.

CODE	VARIABLE	DESCRIPTION/COMMENTS
*CZA	contamination zone 1	yes = 1, no = 0
*CZB	contamination zone 2	yea = 1, no = 0
*CTZA	inside contamination zone 1	yes = 1, no = 0
*CTZB	inside contamination zone 2	yes = 1, no = 0
*CTZD	inside contamination zone 1 and 2 combined	yes = 0, no = 1
DAC	distance to highway access	distance measured in miles
DAR	distance to Route 9	semi dummy: first 1/4 mile = .25, second 1/4 mile = .5, > .5 = 1
*DD1 - DD10	distance from the waste dump in .25 mile dummies	DD1 = first 1/4 mile, DD2 = second 1/4 mile, etc.
DCBD	distance to central business district	distance measured in miles
DHS	distance to high school	within 1/4 mile = .25, between 1/4 and 1/2 mile = .5, over 1/2 mile = 1.
DLF	distance to landfill	within 1/4 mile = .25, between 1/4 and 1/2 mile = .5, over 1/2 mile = 1.
DNS	distance to elementary shcool	within 1/4 mile = .25, between 1/4 and 1/2 mile = .5, over 1/2 mile = 1.
DPW	distance to highway	distance measured in miles
DCBDLN	natural log of DCBD	
DWD	distance to waste dump	distance measured in miles

*Dummy variable.

CODE	VARIABLE	DESCRIPTION/COMMENTS
DWDD	$1/DWD$	
DWDLN	natural log of DWD	
DWDSQ	DWD^2	
*FPL	fireplace	yes = 0, no = 1
GRG	garage	0 car = 0, 1 car = 1, 2 cars = 2, etc.
*GRGB	1 car garage	yes = 1, no = 0
*GRGC	2 car garage	yes = 1, no = 0
*GRCD	3 car garage	yes = 1, no = 0
**HARE	total floor area	measured in square feet
HRELN	natural log of total floor area	
HDEN	average number of homes per acre in enumeration district	see Table 27A on page 73
LSZ	lot size	frontage X depth, additional acres are added. Total converted to sq. ft. (1,000 ft^2)
LSZLN	natural log of lot size	
*MDK	modern kitchen	yes = 0, no = 1
OTBF	outbuildings	total square footage
OTBN	# of outbuildings	
*PLG	inground pool	yes = 1, no pool = 0

*Dummy variable.
**See next section on "Further Comments" for a full description.

CODE	VARIABLE	DESCRIPTION/COMMENTS
*PLV	vinyl pool	yes = 1, no pool = 0
PDEN	average number of rooms per person in enumeration district	See Table 27A
PTO	patio, wooden deck terrace, open deck	Total square footage
PVLN	property values natural log	log of sales prices
PV	property value	sales price in $1000
RM	rooms	living/dining and kitchen/dining = 1.5
RMD	remodeled	remodeled before sale = 0, not remodeled = 1
*SDA to SDFF (1974-1981)	sales dummies	time trended according to quarter year SDA = first quarter of 1974 SDFF = last quarter of 1981
*SDGG to SDBBB (1968 to 1973)		SDGG = last quarter of 1973 SDBBB = third quarter of 1968
SDTRND	sales dummies trend for sample 1	$\sum_{1=A}^{EE} SD_1$ x coefficient SD_1
	sales dummies trend for sample 2	$\sum_{1=GG}^{AAA} SD_1$ x coefficient SD_1
UNITC	unit cost	reproduction cost, dollars per sq. ft. of ground area
* UTWC	municipal water	yes = 1, both municipal water and well water = 0

*Dummy variables.

CODE	VARIABLE	DESCRIPTION/COMMENTS
*UTWW	well water	yes = 1, both municipal and well water = 0
*UTSS	municipal sewerage	yes = 1, both municipal and spetic tank = 0
*UTST	septic tank	yes = 1, both municipal and septic tank = 0
*ZNA to ZNG and ZNI to ZNO	Zoning**	ZNA = Residential, Rural, yes = 1, no = 0
		ZNB = Rural Highway Business (Commercial), yes = 1, no = 0
		ZNC = Rural Highway Business (Residential), yes = 1, no = 0
		ZND = Residential, Cluster R-150, yes = 1, no = 0
		ZNE = Residential R-150, yes = 1, no = 0
		ZNF = Residential, Planned Retirement Community, yes = 1, no = 0
		ZNG = Rural Highway Business, Farm (Commercial), yes = 1, no = 0
		ZNI = Rural Highway Business, Farm (Residential) yes = 1, no = 0
		ZNJ = Residential R-400, yes = 1, no = 0
		ZNK = Highway Business, yes = 1, no = 0
		ZNL = Residential R-200, Farm, yes = 1, no = 0
		ZNM = Residential R-120, yes = 1, no = 0
		ZNN = Residential R-400, Farm, yes = 1, no = 0
		ZNO = Residential R-200, yes = 1, no = 0

*Dummy variables.

**See "Further Comments" for full description.

FURTHER COMMENTS ON THE VARIABLES FROM THE PLEASANT PLAINS SAMPLE

AGE - When a house is sold a few months before it is completed, the age is recorded as zero years instead of negative one year.

AIR - Air conditioning ducts were not considered as air conditioners. In a few instances, air conditioning was added between sales, and the exact date could not be determined. When this occurred, the sale was considered unusable.

BMTC - The finished portion of the basement is measured as a percentage of the groundfloor area.

BTR - The assigned value attributed to this variable is in proportion to the average assessed value for the number of fixtures in each bathroom. If an observation has more than one bathroom, the assigned values are summed. The table below describes the different values.

Assigned Value	Number of Fixtures	Description	Average Assessed Value
1.0	3	Lavatory, shower stall or shower bath	$930
0.5	2	Lavatory and sink	540
		One of the following:	
0.25	1	Lavatory, shower stall, water closet extra, bidet	300

Source: Mr. Henbest, Deputy Tax Assessor, Dover Township, New Jersey.

CL - The class of a house is determined by the quality of its construction and its size. A large, well built house will be classed higher than a small poorly built one. There are ten house classes and they are extensively described in the New Jersey Appraisel Manual. It is important not to confuse CLASS and CONDITION. Condition is only a measure of how well a house has been kept in repair. Both high and low class houses can be in good condition.

House classes are most easily differentiated by the quality and/or quantity of the exterior walls, roof, flooring, interior walls and bathrooms. The Pleasant Plains sample is limited to single family homes of classes CLE to CLI. These classes are described below.

CLE, Below Average Grade. The exterior walls are generally frame with below average grade siding of wood, asphalt, asbestos or stucco. The roof frame is not reinforced and the shingles are of low grade. The floors are softwood or low cost hardwood with linoleum in the bathroom and kitchen. The ceiling and interior walls are painted or of papered plasterboard. There is only one three-fixture bath.

CLF, Average Grade. The exterior wall is frame with average grade siding of wood, asbestos or stucco. The roof frame is not reinforced and the shingles are of average grade. The first floor is hardwood and the upper floors are softwood. There is composition (linoleum) flooring in the kitchen and low cost tile in the bath. The interior walls are painted or papered plasterboard. There is one three-fixture bath.

CLG, Above Average Grade. The exterior and interior walls and the roof are similar to a CLF home. However, the floors are hardwood with composition flooring in the kitchen and ceramic tile in the bathroom. There is one three-fixture bath and a two-fixture toilet room.

CLH, Good Grade. The exterior wall is frame with good grade siding wood or stucco. The roof frame is reinforced and the shingles are of heavy grade. The floors are hardwood with clear oak in principal rooms, good grade composition flooring in the kitchen and ceramic tile in the bathrooms. The interior walls are similar to a CLF home though they may have a textured finish. There is one three-fixture bathroom and a two-fixture toilet room.

CLI, High Grade. The exterior wall is equal to the quality of a class CLH home. The roof frame is reinforced and the slate or tile shingles are commercial grade. The floors are hardwood with clear oak, heavy composition flooring in the kitchen and ceramic tiles in the bathrooms. There are 2 three-fixture bathrooms and 2 two-fixture toilet rooms. The interior walls and ceilings are plastered and they are canvased and decorated.

COND - There are no set guidelines for measuring the condition of a house. Generally, as long as a house is kept repaired, it is considered in good condition. Even though this is a subjective judgment, the same four assessors have been working for the past eight years, which suggests some consistency in judgment.

If the condition variable is unmarked, then the information is taken from the three other condition variables (interior, structure and layout) and vice versa. All of these variables generally indicate the same condition.

DAC - Garden State Parkway access

DCBD - Route 9 and Mapletree St. or Freehold Rd. and Mapletree, whichever is closer.

DHS - Tom's River North High School, Indian Head and Bay Lea Rds.

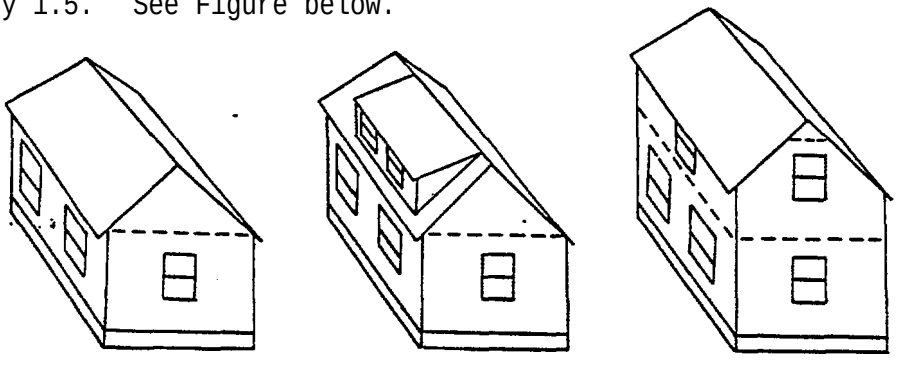
DLF - Located near Bay Rd. and Church Ave.

DNS - Located at North Dover elementary, Church Rd., and New Hampshire Ave.

DWD - Located at Church Rd. and Route 9.

FPL - When it was not possible to determine whether the fireplace was added before or after the sale, the sale was unusable.

HARE - The total floor area is determined by multiplying the groundfloor area by the number of stories. Therefore, the total floor area of a two-story house is two times the groundfloor area. One and a half story (1 1/2S.) To determine the total groundfloor area of a home, the ground-floor area was multiplied by 1.75. The useful floor area of a 1 1/2S home is more closely represented by multiplying the groundfloor area by 1.75 than by 1.5. See Figure below.



1 Story 1-1/2 Story 1-1/2 Story

LSZ - A lot's land size is reported on the property record cards in terms of front footage area and additional land. The two areas are combined to determine total land size. When the land size that exists at the time of a sale could not be determined, the sale was considered unusable.

MDK - This is a subjective evaluation of the kitchen and open to different interpretations. Basically, though, if the range, dishwasher and cabinets are built-in, the kitchen is modern. Non-modern kitchens are of poorer quality, the ranges and ovens are "old fashioned," the cabinets are not built-in and the sinks may be the "old board type."

If modern kitchen was not indicated on the property record card but the house was built in the 1970s, it was considered modern. (Since this variable does not have an impact on assessed value, it is sometimes ignored by the assessors.)

OTBN - An outbuilding is not attached to the main house. The quality and condition of outbuildings were not recorded because they were usually in the same condition. The class of the outbuildings was generally 4 (1 being poor and 10 being excellent), and COND was fair to poor. Garages which are also outbuildings were not included in this variable since they were already recorded.

PTO - The patio variable sums the area of all patios, wooden decks, terraces and open porches. Patios are often added between sales and therefore it is important to determine which patios existed at the time of sale. The assessed values of patios vary from $.50 to $8.00 per square foot.

RM/BDR - Rooms and bedrooms may not be reported accurately on the property record cards. The number of rooms is of minor importance to the assessment office since they do not affect the assessment value. (There is no change in assessment if a room is divided in two.)

The rooms covered by this variable are the living room, dining room, bedroom, utility room, kitchen and recreation room. If the living and dining room or kitchen and dining room are combined, they are counted as 1.5 rooms.

There was one observation with only three rooms.

Room data was not recorded on approximately 10% of the property record cards. Therefore, the average number of rooms and bedrooms were computed for both the before and after samples and then substituted for the missing data. The respective averages for the two samples are 6.5 and 3.2 for the post-1975 sales and 5.6 and 2.6 for the pre-1976 sales.

MD - This dummy variable indicates whether a house was remodeled prior to the sale. When it was impossible to determine if the remodeling took place before or after a sale, the observation was considered unusable. It is important to determine exactly when remodeling occurs, since there are sometimes more than one sale on a property record card.

SD - Sale dates were converted from years and quarters to dummy time trended variables according to the following tables:

Pre-1974	
Year/Quarter	Values
1973/4 - 1973/1 =	-3 - 0
1972/4 - 1972/1 =	-4 - -7
1971/4 - 1971/1 =	-8 - -11
1970/4 - 1970/1 =	-12 - -15
1969/4 - 1969/1 =	-16 - -19
1968/4 - 1968/1 =	-20 - -23

Post-1974	
Year/Quarter	Values
1974/1 - 1974/4 =	1 - 4
1975/1 - 1975/4 =	5 - 8
1976/1 - 1976/4 =	9 - 12
1977/1 - 1977/4 =	13 - 16
1978/1 - 1978/4 =	17 - 20
1979/1 - 1979/4 =	21 - 24
1980/1 - 1980/4 =	25 - 28
1981/1 - 1981/4 =	29 - 32

UTSS, UTST - When a property's water facilities are not recorded, the property is given the same facilities as its neighbors.

ZN - Residential zones are always marked with a number which pertains to minimum lot area: example R-800 = a minimum lot area of 80,000 square feet. Permitted uses for all residential zones include (1) single family dwellings; (2) non-profit private and parochial schools; (3) government buildings; and (4) essential services.

ZNA = Rural Residential

Minimum lot size: 43,560 sq. ft. (1 acre). Cluster development permitted in accordance with regulations. Permitted uses are those of all residential zone.

ZNB = Rural Highway Business Zone (RHB) (commercial).

Minimum lot size: 43,560 sq. ft. (1 acre). Permitted uses included (1) general commercial activities such as professional offices, instructional schools, eating and drinking establishments, and retail and wholesale stores. Major stipulation is that goods/raw materials cannot be processed chemically or physically, resulting in a change in the nature of the good, and (2) single-family, two-family and multi-family dwellings.

ZNC = RHB (residential).

Description same as ZNB.

ZND = Residential Zone; cluster (R-150).
R-150 zone does not distinguish between cluster and non-cluster.

Minimum lot size for cluster: 7,500 sq. ft. Permitted uses are those of all residential zones.

ZNE = Residential Zone; not cluster (R-150).

Minimum lot size: 15,000 sq. ft. Cluster development permitted in accordance with regulations. Permitted uses are those of all residential zones.

ZNF = Planned Retirement Community Zone (PRC).

Minimum lot size: 5,000 sq. ft. per unit. Permitted uses include (1) single-family dwellings (subject to provisions); (2) recreation, cultural and medical facilities, (3) essential services.

ZNG = Rural Highway Business; used, farm (RHB).
Same as ZNB in all aspects. Only difference is that the land is assessed at a lower value, which reduces property taxes.

ZNI = Rural Highway Business; unused, farm (RHB).
Same as ZNG but not used for business.

ZNJ = Residential Zone (R-400).

Minimum lot size: 43,560 sq. ft. (1 acre). Permitted uses are those of all residential zone. Cluster development permitted in accordance with regulations.

ZNK = HB Highway Business.

ZNL = Residential; farm (R-200).
Same as ZNJ, except that land is assessed as farm land.

ZNM = Residential (R-120).

Minimum lot size: 12,000 sq. ft. Permitted uses are those of residential zone. No cluster development permitted.

ZNN = Residential; farm (R-400).
Same as ZNJ except that land is assessed as farm land.

ZNO = Residential (R-200).

Minimum lot size: 20,000 sq. ft. Permitted uses are those of all, residential zones (RHB). Cluster development permitted in accordance with regulations.

TABLE 27A

Enumeration District	Total Persons	Single Family Homes (1)	Mean Rooms Per Home (2)	Persons Per Unit	Rooms Per Persons	ED Land Area (Acres)	Single Family Homes Per Acre
501	247	91	5.3	2.8	1.9	674	.37
498	611	178	7.2	3.7	1.9	625	.98
409	288	100	6.7	3.5	1.9	829	.35
496	787	203	6.7	4.3	1.6	348	2.26
518	1,861	478	7.6	3.9	2.0	384	4.85
507	220	74	5.7	3.1	1.8	307	.76
505	445	131	6.9	3.4	2.0	104	4.28
508	495	273	4.5	1.9	2.4	140	3.54
509	642	290	4.9	2.3	2.1	147	4.37
500	74	24	7.2	3.5	2.1	132	0.18
Total	5,670	1,842					

Mean Rooms - Persons Per Unit: Mean calculated by taking the weighted average by single family homes.
Mean Rooms is calculated from "Year Round Housing."

(1) One unit at address

(2) Year round housing

B. Andover

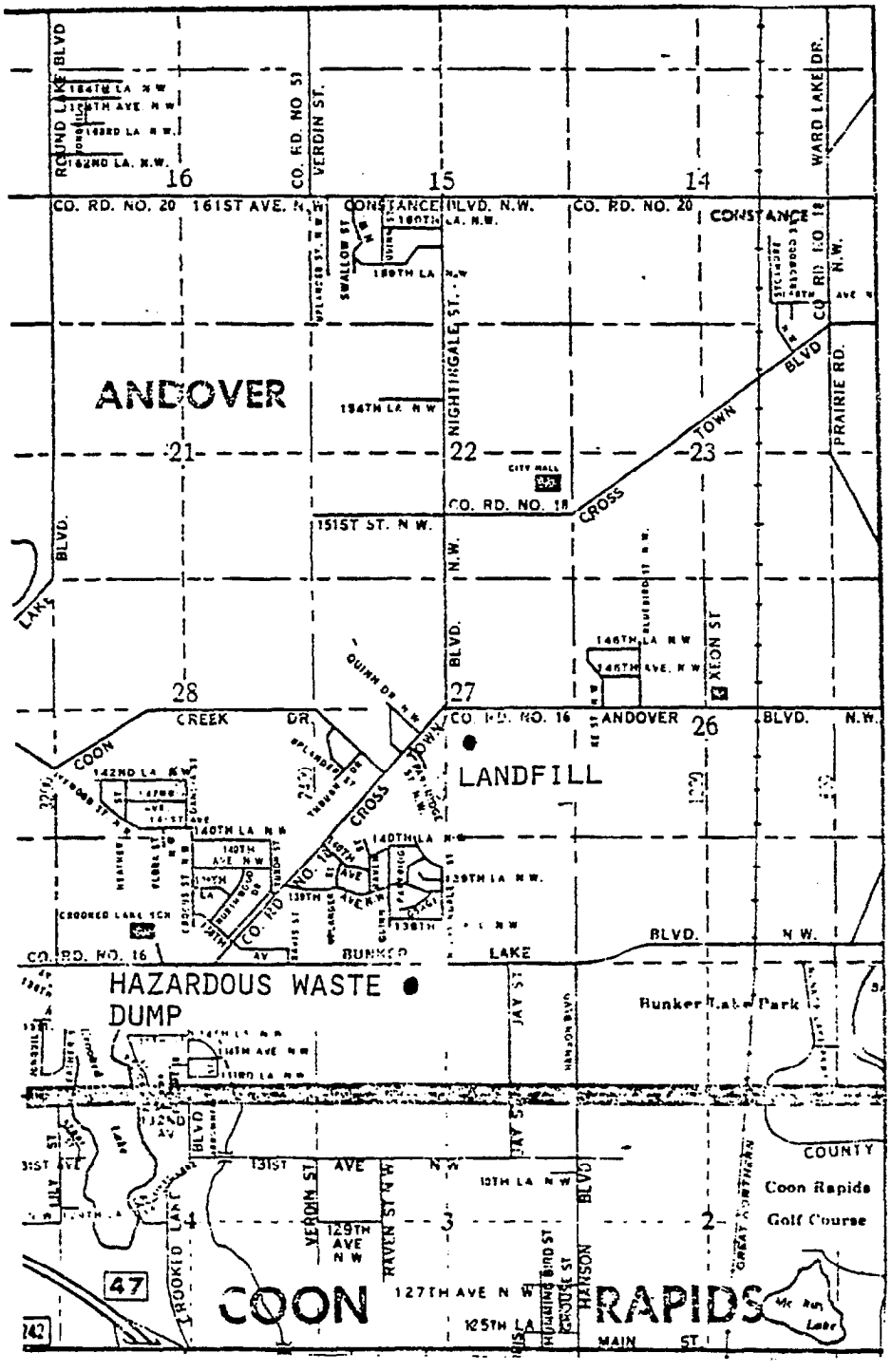
This section of Appendix C reports the results of the Andover study. Of primary concern are the five adjoining facilities just south of Bunker Lake Boulevard where, over a period of years, numerous barrels of waste solvents, paints, inks, glues and grease were dumped. The site, which from here on will be referred to as the waste dump, is located in the most southerly section of Andover approximately 20 miles north of Minneapolis. A complicating factor is the municipal landfill located south of Andover Boulevard next to Coon Creek and about a mile north of the dump. (See Map 2.)

To ascertain the economic impact of the dump, sale prices are regressed against several explanatory variables of housing characteristics in addition to distance from the dump and distance from other neighborhood amenities and disamenities. Sale prices for properties sold over a three-year period (1978-1981) and scattered within a 3.5 mile radius of the waste dump site were utilized. Data on housing sales and characteristics were obtained from the county assessor's office in Anoka, Minnesota. The overall results strongly suggest that for properties near the waste dump no decline in value occurred after groundwater contamination was discovered.

Like the Pleasant Plains case, several specifications were tried for the purpose of generating the theoretically most appropriate and significant model. In general, all the independent variables carried the correct sign except for housing unit density. However, caution must be exercised in interpreting this variable since the less densely populated homes may be located in the more rural areas where the property value is lower to

Map 2

Andover



begin with. Anyway, too much concern should not be given to this variable since it proved consistently to be insignificant. Other independent variables (especially the locational variables) tended to fluctuate in their levels of significance depending on the other variables present in the equation.

A semi-log specification was used for all but the last regression, which had a double log specification. In all cases, explanatory variables were regressed on the log of property values. The first three equations (Tables 28-30) were run stepwise. The reported results as well as any accompanying analysis for these equations are based on the steps which produced the best overall results. This was on the basis of mutually consistent criteria of a high $\bar{R}^2$ and significant F ratios.

The original variables, as indicated by Table 28, were all entered in the first regression. Although the landfill and waste dump were suspected of being highly collinear due to the close proximity of the two facilities, both were entered in the regression since this was mainly an experimental run. Similarly, BTR, BDR and RM were all entered in the first run because of its experimental nature. The omitted dummies in this case are the sale dummy representing the second quarter of 1978 (SD1), two story houses and municipal water.

The step which yielded the best results is presented in Table 28. At this point, four variables (DCL, BM, OQRS and DWD) were excluded from the equation on the basis of the minimum F criteria of the stepwise principle. It was surprising that, of the waste dump and the landfill, the latter was the stronger with a very significant F of 8.288 (the waste dump had an F of 0.0). A correlation coefficient of .82036 between the waste dump and

the landfill and one of .58679 between rooms and bedrooms confirmed earlier suspicions of multicollinearity.

In order to reduce the multicollinearity, a second regression was run with DLF and BDR omitted. Removal of the landfill improved the significance of the waste dump (from 0.0 to 2.915). However, this is still below an F of 4.0 for a two-tailed test at the 95% level of confidence. The RM variable improved dramatically in its significance as a result of the omission of BDR.

From the first two regressions, a high degree of interaction was noticed among the several neighborhood variables. In addition, coefficients on the original specification of the variables representing distance from the school (DHS, DJHS, DES) proved difficult to interpret. According to the specification, similar distances for the same level school (high school, junior high, etc.), regardless of the location of the school, were given equal weight. For example, the two high schools, Blaine and Coon Rapids were represented by a single variable (DHS) in which case observations that were one half mile away from the respective schools were given the same weight, making it difficult to distinguish the effect of each school. In order to make the school variables more meaningful, amendments were made in the form of a semi-dummy applied to each school separately. For each school, a weight of .25 was given if distance from the observation was up to one-quarter mile, a weight of .5 was given for distances between one quarter and one-half mile, and 1 for distances greater than one-half mile.

As Table 305 indicates, the explanatory power of the neighborhood variables as well as the $\overline{R}^2$ improved dramatically with the new specification

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[5] Prior to this point, SD1 was the sales dummy being omitted, but from the first two regressions, some inconsistency between the number of stories and property values was discovered in one of the observations and the observation was deleted. Since this was the only relevant sale for that quarter, and SD2 had no observation to begin with, SD3 became the omitted dummy.

of the school variables and the exclusion of the contamination variables. Note that omission of the waste dump was not a deliberate effort but was a result of the stepwise principle. Surprisingly, the locational variables which were most highly correlated with dump were omitted from the equation along with it.

Additional changes associated with the recreational variable are reflected in the results reported in Table 30. Distance from Crooked Lake (DCL), in its original specification appeared to be capturing recreational benefits only and was respecified to capture recreational as well as aesthetic effects. The variable was transformed from a continuous variable into a dummy variable for distinguishing property value effects between homes that are within one quarter mile of the lake and those outside. Similar changes for the other recreational site (distance from Bunker Hill Park) were incorporated. (A variable is added later *to* capture lake view.)

Up to this point, there has been no clear evidence from the results that the presence of the waste dump triggered any substantial decline in property values. The following discussion focuses on the contamination itself as it outlines the steps that were taken to investigate the relationship, if any, between property values and the waste dump.

Tables 31-33[6] represent the efforts to isolate the relationship between property values and the dump at various distances, and to further test the hypothesized existence of a distance gradient. For this, the dump was disaggregated into one quarter mile dummies (with DWD1 representing the

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[6]The equations with the neighborhood variables present are represented by Model A, to be distinguished from Model B which incorporates none of the neighborhood variables. Since in both instances, the proxy for the contamination variable is distance, both Model A and Model B fall within the specification of Model 1 in Chapter IV of the main body of the report.

first one quarter mile, DWD2 representing the second quarter mile, etc.). As Figure 7 illustrates, contrary to prior hypothesis, the dummy variables were all insignificant and when plotted, failed to yield a gradient. One might argue that by a process of elimination (based on the lowest F criteria), a number of variables should have by now been omitted from the model. This might be valid; however, a deliberate effort was made to introduce the contamination dummies with as many of the original variables as possible.

Distance from the landfill was also disaggregated into one quarter mile dummies and entered independently of the dump into regression 32. As was the case with the dump, the landfill failed to show any systematic change in property values (Figure 8).

Table 33 reports and Figure 9 illustrates the results from combining the dummy variables of both environmental variables with the exact same variables from the two previous equations.

It may be observed from the figure that the tendency was for the dump to become stronger but generally remaining insignificant. This relationship between the waste dump and landfill was unpredicted based on the results when these variables are entered independently. However, this is just further evidence of multicollinearity which should not be totally surprising since, for the greater proportion of the sample, distance from the landfill will increase as distance from the waste dump increases.

The next three regressions (34, 35, 36) essentially reflect the effort to minimize the multicollinearity, on the one hand, between the dump and the landfill, and, on the other, between each of these environmental

DISTANCE COEFFICIENTS FROM TABLES 31 - 33

FOR FIGURE 7

Distance (miles)	DWD Coeff.	DWD F	Obs.
0 ≥ .25	*	*	4
.25 ≥ .50	-.0270	.131	14
.50 ≥ .75	-.0297	.152	17
.75 ≥ 1.00	-.0538	.502	31
1.00 ≥ 1.25	.1056	.018	25
1.25 ≥ 1.50	-.0223	.079	28
1.50 ≥ 1.75	-.0731	.605	6
1.75 ≥ 2.00	-.0288	.104	25
2.00 ≥ 2.25	.0180	.035	22
2.25 ≥ 2.50	.1297	1.432	12
2.50 ≥ 2.75	.0195	.034	12
2.75 ≥ 3.00	-.0164	.023	20
3.00 ≥ 3.25	.0183	.028	25
3.25 ≥ 3.50	-.0057	.002	5
3.50 ≥ 3.75	**	**	0
3.75 ≥ 4.00	.0026	.000	1

FOR FIGURE 8

Distance (miles)	DLF Coeff.	DLF F	Obs.
0 ≥ .25	*	*	3
.25 ≥ .50	-.1073	2.079	8
.50 ≥ .75	-.0387	.314	15
.75 ≥ 1.00	-.0696	.827	9
1.00 ≥ 1.25	-.0708	.850	12
1.25 ≥ 1.50	.0070	.008	10
1.50 ≥ 1.75	-.0219	.082	13
1.75 ≥ 2.00	-.0315	.219	17
2.00 ≥ 2.25	.0139	.031	17
2.25 ≥ 2.50	.0370	.209	10
2.50 ≥ 2.75	-.0138	.008	1
2.75 ≥ 3.00	**	**	0
3.00 ≥ 3.25	-.0769	.191	4
3.25 ≥ 3.50	-.0030	.000	5
3.50 ≥ 3.75	-.1813	1.076	4
3.75 ≥ 4.00	-.1090	.429	7
4.00 ≥ 4.25	-.0588	.114	13
4.25 ≥ 4.50	-.1059	.344	18

FOR FIGURE 9

Distance (miles)	DWD Coeff.	DWD F	Obs.	DLF Coeff.	DLF F	Obs.
0 ≥ .25	*	*	4	*	*	3
.25 ≥ .50	-.0473	.366	14	-.0917	1.486	8
.50 ≥ .75	-.0455	.342	17	-.0063	.007	15
.75 ≥ 1.00	-.0703	.764	31	-.0265	.099	9
1.00 ≥ 1.25	-.0420	.217	25	.0122	.019	12
1.25 ≥ 1.50	-.1667	3.027	28	.1516	2.087	10
1.50 ≥ 1.75	-.2810	4.695	6	.1282	1.291	13
1.75 ≥ 2.00	-.2831	4.078	25	.1812	2.227	17
2.00 ≥ 2.25	-.2643	2.912	22	.2214	2.860	17
2.25 ≥ 2.50	-.1870	1.141	12	.2861	4.023	10
2.50 ≥ 2.75	-.3306	2.469	12	.3877	2.426	1
2.75 ≥ 3.00	-.4222	3.747	20	**	**	0
3.00 ≥ 3.25	-.4490	3.773	25	.2665	.693	4
3.25 ≥ 3.50	-.4289	2.656	5	.2503	.555	5
3.50 ≥ 3.75	**	**	0	.2130	.347	4
3.75 ≥ 4.00	-.4989	1.217	1	.3687	1.056	7
4.00 ≥ 4.25	N.A.	N.A.	N.A.	.4784	1.533	13
4.25 ≥ 4.50	N.A.	N.A.	N.A.	.4423	1.155	18

*Ommitted Dummy
**No Observations
Obs. - Number of Observations
N.A. - Not Applicable

Figure 7

Model A: Distance From Waste Dump
Along with All Neighborhood Variables (Table 31)

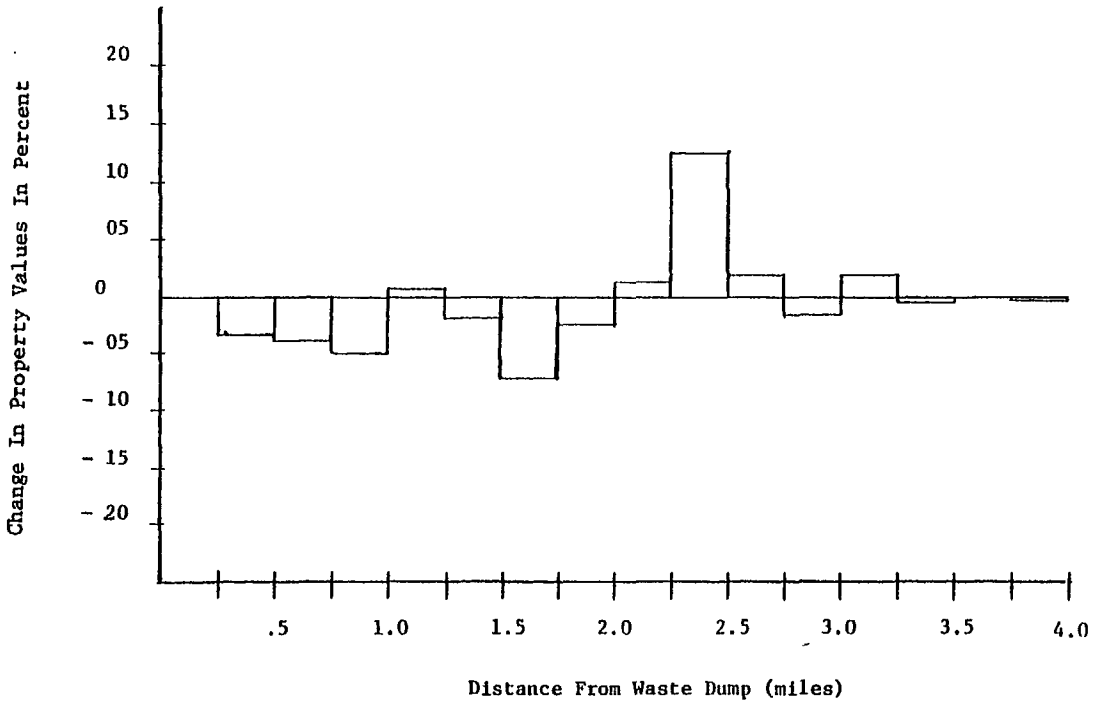


Figure 8

Model A: Distance From Landfill
Along With All Neighborhood Variables (Table 32)

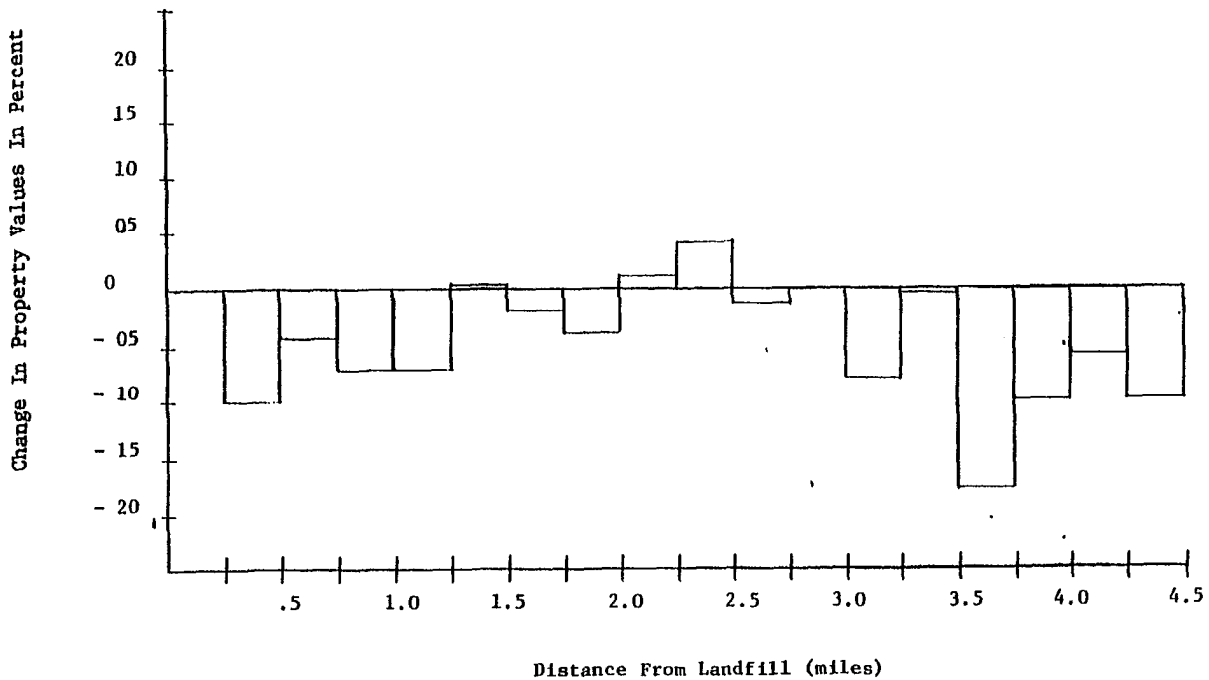
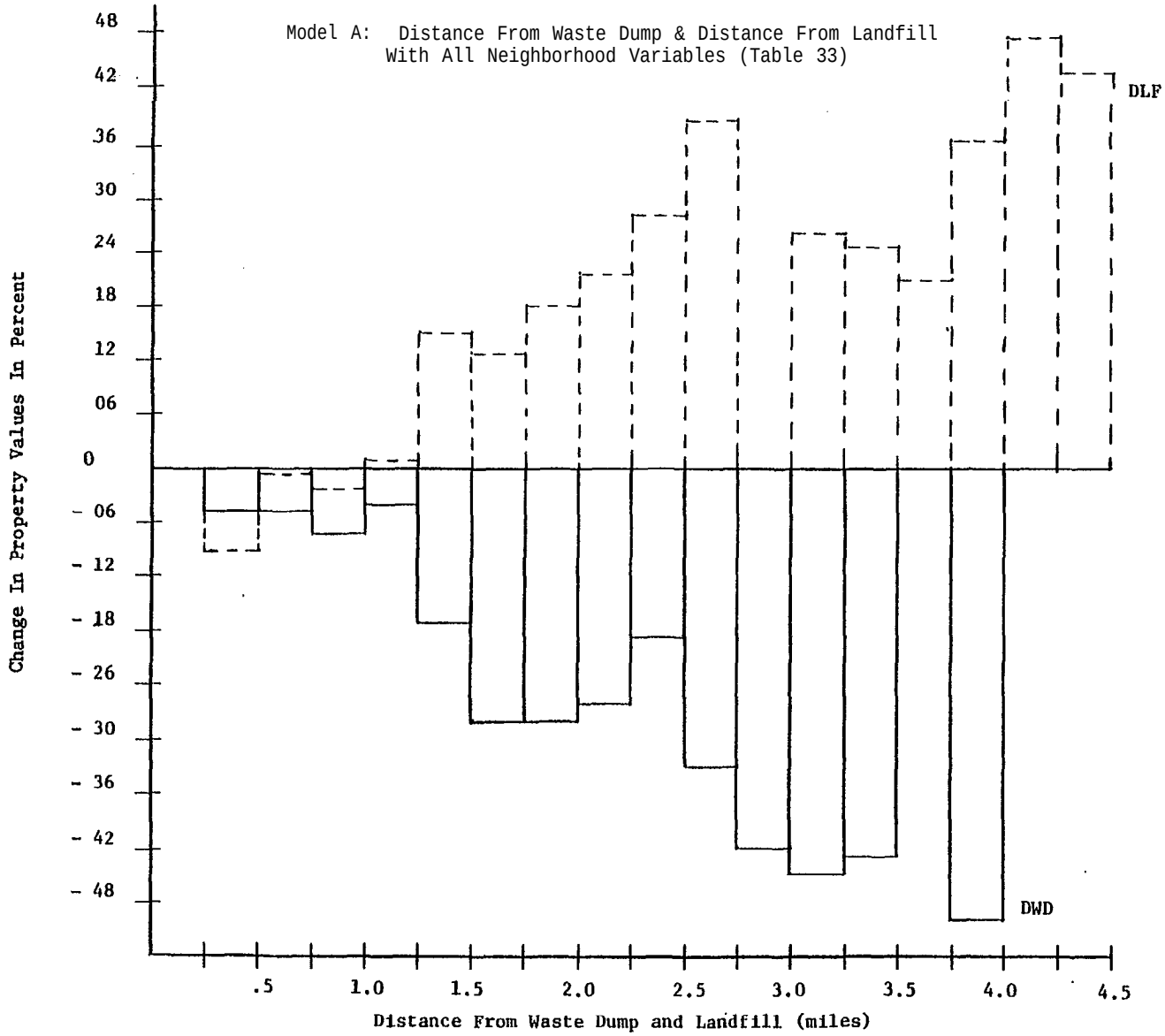


Figure 9

Model A: Distance From Waste Dump & Distance From Landfill
With All Neighborhood Variables (Table 33)



variables and the neighborhood amenities. The dump and landfill in their dummied forms were run in regressions 34 and 35, respectively, with all other neighborhood variables omitted. The other equation combined DWD and DLF with all the other variables in the above two runs. Results from these runs were compared with those in Tables 31-33.

Note that Tables 31-33 and 34-36 represent two different models.[7] The first had present all of the neighborhood variables. The second model, in contrast, omitted all the neighborhood variables. The results of the two models exhibit the same general pattern for the contamination dummies (Figures 7-9 and 10-12). The only exception was between Figures 7 and 10 where, with the omission of the locational variables, there was a much stronger (unpredicted) negative relationship between property values and the dump as distance increases. Further, when these two models are compared with the results in Table 30, it can be observed that the neighborhood variables are significant when the contamination variables are omitted, even though the reverse is not true. This is further evidence for believing that the dump fails to explain changes in property values.

At this point, it was suspected that the unexplained variation in the model was concentrated in the vicinity of the dump and was somehow responsible for its insignificance. Hence, another equation was run with all the distance variables omitted. Residuals from that regress&on were plotted against the observations on a detailed map of the area in an attempt to establish whether the large residuals were concentrated in the vicinity of the landfill and/or the dump. However, plotting indicated that the spectrum of (+ to -) residuals were very well dispersed. More

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[7] See Footnote 6.

importantly, the large residuals were not concentrated in the geographic area of either the landfill or dump.

Later, the dump was represented as a single weighted linear term (where DWDT=1 for the first quarter mile from the waste dump and DWDT=2 for the second quarter mile, etc.). Three additional variables were also incorporated into the analysis: person density (PDEN), lake view (LKV) and distance from the Burlington Railroad tracks (DBR). At this point, the distance from the Crooked Lake variable in its various forms was omitted since it had so far proven to be insignificant. Nevertheless, a priori knowledge dictated that proximity to the lake should affect property values. Consequently, the variable (Lake View) was created to capture the benefits of residents who had a view of not only Crooked Lake but Round Lake also.

DISTANCE COEFFICIENT FROM TABLES 34 - 36

FOR FIGURE 10

Distance (miles)	DWD Coeff.	DWD F	Obs.
0 ≥ .25	*	*	4
.25 ≥ .50	-.0521	.485	14
.50 ≥ .75	-.0461	.389	17
.75 ≥ 1.00	-.0542	.568	31
1.00 ≥ 1.25	-.0047	.004	25
1.25 ≥ 1.50	-.0172	.059	28
1.50 ≥ 1.75	-.0760	.790	6
1.75 ≥ 2.00	-.1075	2.150	25
2.00 ≥ 2.25	-.0853	1.353	22
2.25 ≥ 2.50	.0135	.029	12
2.50 ≥ 2.75	-.0497	.379	12
2.75 ≥ 3.00	-.0999	1.780	20
3.00 ≥ 3.25	-.0424	.319	25
3.25 ≥ 3.50	-.0466	.227	5
3.50 ≥ 3.75	**	**	0
3.75 ≥ 4.00	-.2838	3.571	1

FOR FIGURE 11

Distance (miles)	DLF Coeff.	DLF F	Obs.
0 ≥ .25	*	*	3
.25 ≥ .50	-.0615	.692	8
.50 ≥ .75	.0118	.032	15
.75 ≥ 1.00	.0011	0	9
1.00 ≥ 1.25	-.0084	.015	12
1.25 ≥ 1.50	.0654	.866	10
1.50 ≥ 1.75	.0616	.839	13
1.75 ≥ 2.00	-.0434	.465	17
2.00 ≥ 2.25	-.0287	.205	17
2.25 ≥ 2.50	.0517	.600	10
2.50 ≥ 2.75	-.0026	0	1
2.75 ≥ 3.00	**	**	0
3.00 ≥ 3.25	.0011	0	4
3.25 ≥ 3.50	.0298	.089	5
3.50 ≥ 3.75	-.0777	.557	4
3.75 ≥ 4.00	-.0128	.019	7
4.00 ≥ 4.25	.0188	.044	13
4.25 ≥ 4.50	-.0176	.029	18

FOR FIGURE 12

Distance (miles)	DWD Coeff.	DWD F	Obs.	DLF Coeff.	DLF F	Obs.
0 ≥ .25	*	*	4	*	*	3
.25 ≥ .50	-.0639	.710	14	-.0378	.270	8
.50 ≥ .75	-.0755	1.043	17	.0454	.408	15
.75 ≥ 1.00	-.0525	.484	31	.0262	.126	9
1.00 ≥ 1.25	-.0011	.000	25	.0076	.013	12
1.25 ≥ 1.50	-.0980	1.551	28	.1719	5.113	10
1.50 ≥ 1.75	-.1612	2.746	6	.0929	1.934	13
1.75 ≥ 2.00	-.1944	5.314	25	.0692	1.008	17
2.00 ≥ 2.25	-.1554	3.392	22	.0962	1.705	17
2.25 ≥ 2.50	-.0792	.664	12	.1725	5.327	10
2.50 ≥ 2.75	-.0955	1.027	12	.1390	.779	1
2.75 ≥ 3.00	-.1769	4.006	20	**	**	0
3.00 ≥ 3.25	-.1674	3.341	25	.2590	4.336	4
3.25 ≥ 3.50	-.1050	.355	5	.2717	4.173	5
3.50 ≥ 3.75	**	**	0	.1268	1.034	4
3.75 ≥ 4.00	-.5253	7.928	1	.2507	4.851	7
4.00 ≥ 4.25	N.A.	N.A.	N.A.	.2779	5.713	13
4.25 ≥ 4.50	N.A.	N.A.	N.A.	.2038	1.352	18

*Ommitted Dummy
**No Observations
Obs. - Number of Observations
N.A. - Not Applicable

Figure 10

Model B: Distance From Waste Dump
Without Neighborhood Variables (Table 34)

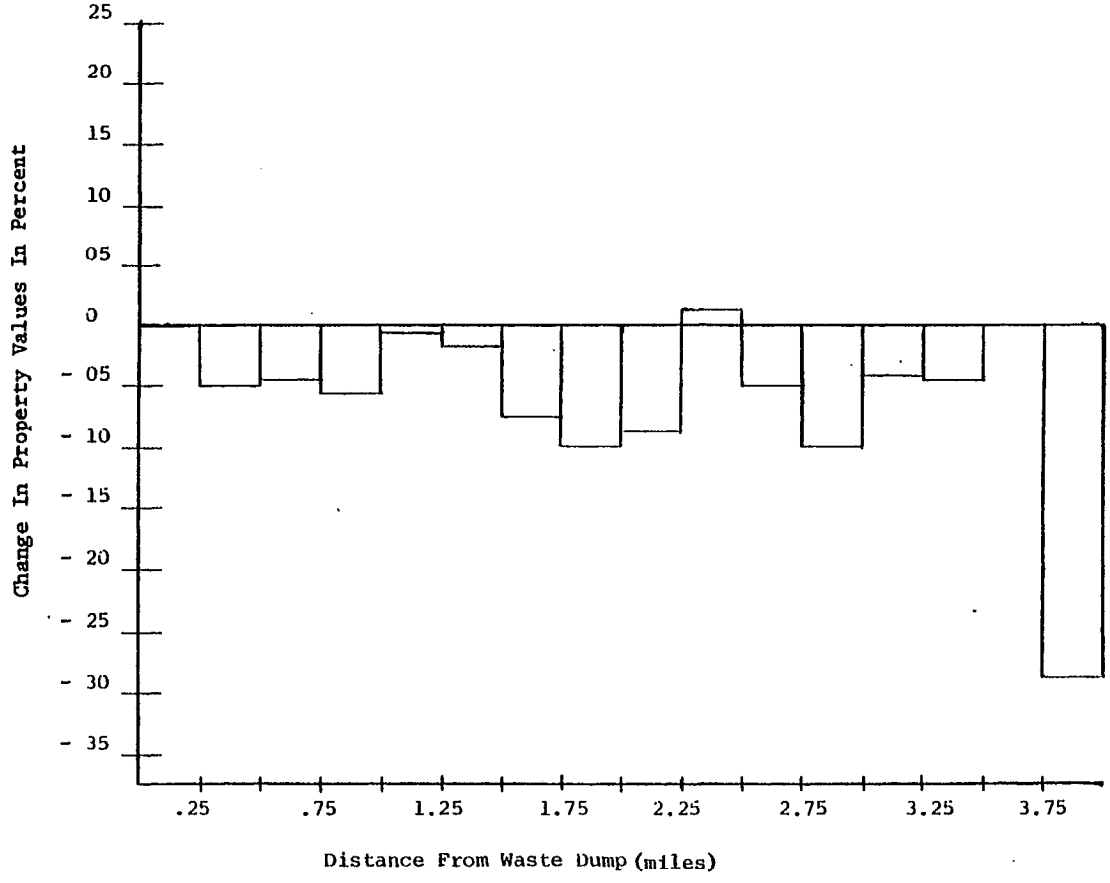


Figure 11

Model B: Distance From Landfill
Without Neighborhood Variables (Table 35)

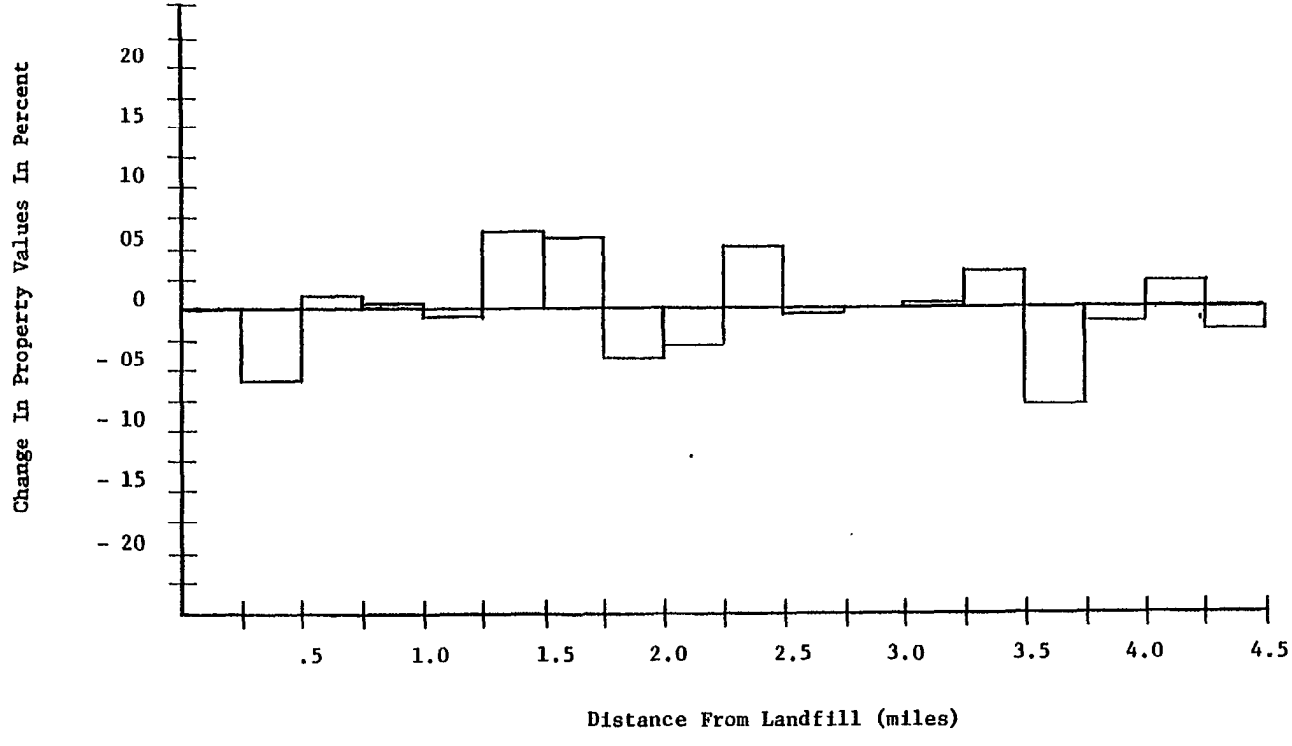
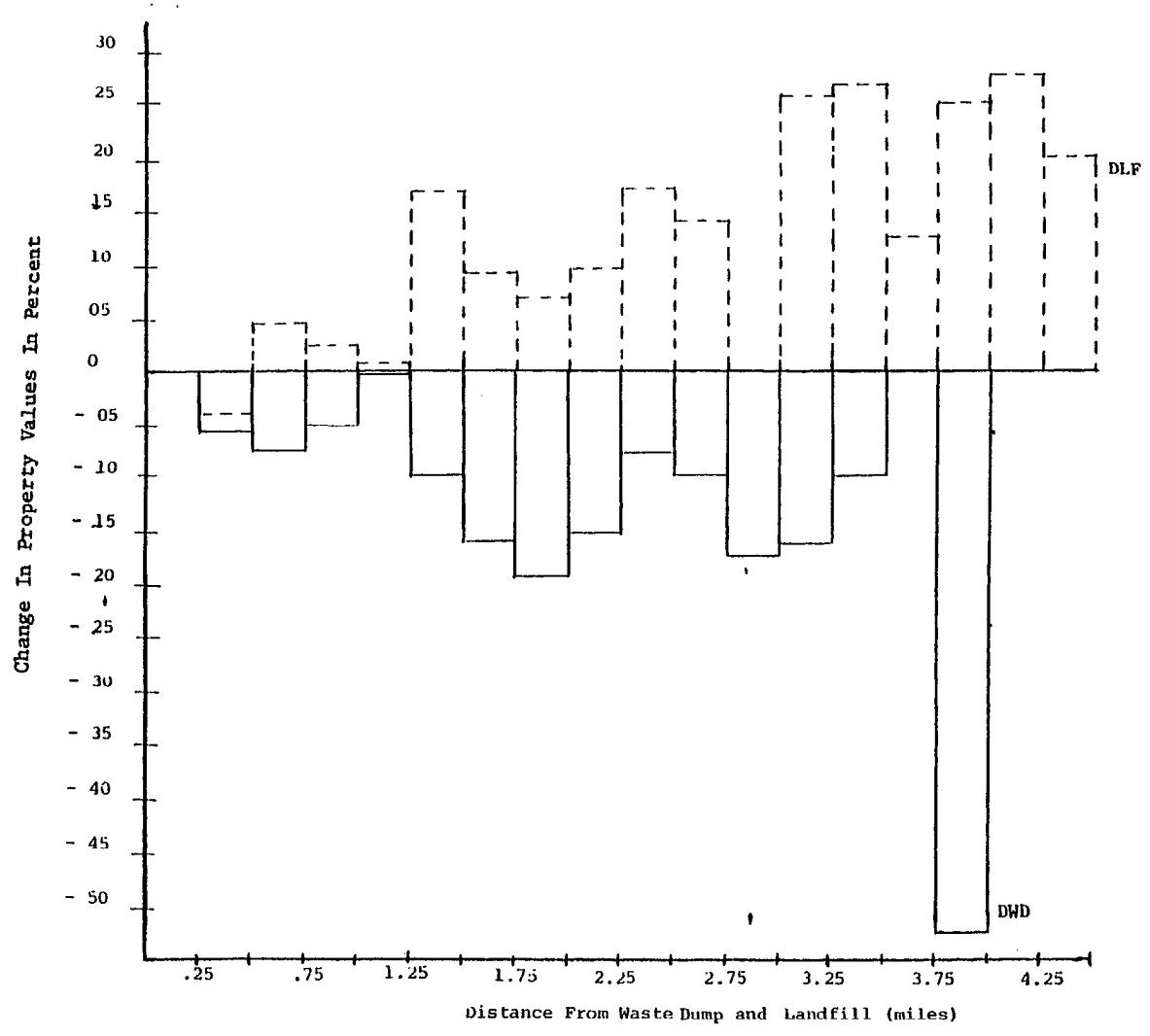


Figure 12

Model B: Distance From Waste Dump & Distance From Landfill Without Neighborhood Variables (Table 36)



From the results in Table 37, the waste dump variable specified as a weighted linear term did not seem to offer any further explanation for variation in property values. The newly added variable, LKV, was significant, but DBR and PDEN were not.

Also reflected in Table 37 are changes in the specification of the lot size and bedroom variables. These variables are suspected of having decreasing returns to scale and were therefore entered in a log form. There is no indication that variables improved in significance as a result.

TABLE 28

NATURAL LOG OF PROPERTY VALUES REGRESSED ON DISTANCE FROM THE WASTE SITE AND DISTANCE FROM THE LANDFILL (STEPWISE)

---------- Variables in the equation ----------

Variable	B	Std error B	F
GFA	0.4919430D-03	0.00006	71.727
OOMS	-0.4795946D+00	0.09285	26.682
RAM	-0.1809991D+00	0.04545	15.859
BTR	0.1033363D-01	0.02852	0.131
DBA	-0.1306986D+00	0.04432	8.695
DLF	0.1107386D+00	0.03846	8.269
SD3	0.2685254D+00	0.16234	2.736
RY	0.1181595D-01	0.00926	1.628
SD4	0.4265343D+00	0.14994	8.092
SD5	0.4288497D+00	0.14870	8.317
AGE	-0.4330205D-02	0.00103	17.757
SD6	0.4318166D+00	0.15097	8.181
LSZ	0.2141311D-05	0.00000	8.384
FP	0.4469894D-01	0.02157	4.295
SD9	0.4856086D+00	0.15084	10.364
HUDENS	0.3829300D-01	0.02495	2.355
GG	0.6009456D-01	0.04618	1.693
SD7	0.5088249D+00	0.15312	11.043
SD8	0.5113413D+00	0.15449	10.965
SE	-0.1214214D+00	0.04516	7.230
SL	-0.1445396D+00	0.05509	6.884
DES	-0.2606306D-01	0.02115	1.516
DHS	0.1491883D-01	0.01880	0.630
DHWY	0.3567139D-01	0.02946	1.466
DCBD	-0.2869325D-01	0.02970	0.933
DJHS	0.2062524D-01	0.01818	1.287
BDR	0.1676191D-01	0.01631	1.056
SD15	0.5916330D+00	0.15951	13.757
SD13	0.5738921D+00	0.15295	14.078
SD10	0.5581651D+00	0.15144	13.595
WWTP	0.3068781D-01	0.04314	0.513
HDENS	0.6131426D-04	0.00009	0.422
SD14	0.5526441D+00	0.15491	12.743
SD11	0.5339109D+00	0.15053	12.581
SD12	0.5216660D+00	0.15670	11.063
(Constant)	0.2906087D+01		

---------- Variables not in the equation ----------

Variable	F
DCL	0.001
BM	0.247
DQRS	0.028
DWD	0.000

Analysis of variance	Df	Sum of squares	Mean square	F
Regression	35.	8.06063	0.23088	13.04734
Residual	214.	3.78677	0.01770	

Multiple R	0.82517
R square	0.68091
Adjusted R square	0.62872
Standard error	0.13302

TABLE 29

NATURAL LOG OF PROPERTY VALUES REGRESSED ON DISTANCE FROM THE WASTE SITE (STEPWISE)

---------- Variables in the equation ----------

Variable	B	Std error B	F
GFA	0.4963107D-03	0.00006	75.901
ODHS	-0.4654162D+00	0.09243	25.353
RAM	-0.1761796D+00	0.04515	15.218
BTR	0.2335095D-02	0.02849	0.007
DBW	-0.3898805D-01	0.03229	7.563
DJHS	-0.1273585D-01	0.01021	1.556
SD3	0.2589513D+00	0.16270	2.533
LSZ	0.2032901D-06	0.00000	7.511
RM	0.1914052D-01	0.00708	7.305
AGE	-0.4468432D-02	0.00101	19.826
SD4	0.4298692D+00	0.15038	8.171
SD5	0.4369437D+00	0.14915	8.582
SD6	0.4401884D+00	0.15144	8.449
FP	0.4480111D-01	0.02130	4.424
GG	0.7421169D-01	0.04565	2.642
SD9	0.4908654D+00	0.15129	10.527
SD7	0.4969169D+00	0.15336	10.498
SD8	0.5040124D+00	0.15500	10.573
DHS	0.9778773D-02	0.01579	0.383
SE	-0.1214926D+00	0.04514	7.244
SL	-0.1373094D+00	0.05435	6.382
HUDENS	0.3694149D-01	0.02563	2.078
DWD	0.5432311D-01	0.03182	2.915
DES	-0.2686871D-01	0.01783	2.271
SD13	0.5879167D+00	0.15343	14.682
SD15	0.6004268D+00	0.15997	14.087
SD14	0.5791186D+00	0.15474	14.007
SD10	0.5612053D+00	0.15195	13.641
SD11	0.5380850D+00	0.15106	12.689
SD12	0.5258054D+00	0.15722	11.185
(Constant)	0.3093838D+01		

---------- Variables not in the equation ----------

Variable	F
DCL	0.430
DCBD	0.350
DHWY	0.550
BM	0.251
BDR	0.699
HDENS	0.676
WWTR	0.152
OQRS	0.080

Analysis of variance	Df	Mean square	Sum of squares	F
Regression	30.	0.26527	7.95812	14.86063
Residual	219.	0.01785	3.90928	

Multiple R	0.81889
R square	0.67059
Adjusted R square	0.62546
Standard error	0.13361

TABLE 30

NATURAL LOG OF PROPERTY VALUES REGRESSED ON DISTANCE FROM THE WASTE SITE AND ALL OTHER NEIGHBORHOOD VARIABLES (STEPWISE)

---------- Variables in the equation ----------

Variable	B	Std error B	F
GFA	0.4541857D-03	0.00005	72.009
AGE	-0.3944935D-02	0.00114	11.878
BTR	0.2837244D-01	0.02500	1.288
DBHD	-0.1222237D+00	0.03820	10.236
OOHS	-0.7630321D+00	0.13389	32.479
RAM	-0.2972660D+00	0.05153	33.273
HUDENS	0.2638154D-01	0.02336	1.275
SE	-0.2408793D+00	0.05045	22.795
SL	-0.2455009D+00	0.05869	17.499
GG	0.8950895D-01	0.04310	4.312
SD4	0.1398419D+00	0.06222	5.052
SD6	0.1384064D+00	0.06333	4.777
SD5	0.1616718D+00	0.06185	6.933
FP	0.5502971D-01	0.02025	7.383
BDR	0.3536861D-01	0.01185	8.910
LSZ	0.2012333D-06	0.00000	7.927
SD15	0.3436920D+00	0.07927	18.798
SD13	0.3146079D+00	0.06618	22.600
SD10	0.2788232D+00	0.06545	18.146
OQRS	-0.1739249D+00	0.08827	3.883
DWAE	-0.2068042D+00	0.09435	4.804
DWE	-0.1062714D+00	0.05240	4.113
DSCE	-0.2352206D+00	0.10978	4.591
SD14	0.2774046D+00	0.06930	16.025
DCLO	0.5056958D-01	0.06174	0.671
DHWY	-0.4340500D-01	0.02065	4.412
DCRJ	-0.1467869D+00	0.05029	8.519
DCLE	-0.1299131D+00	0.05491	5.598
DCBD	0.4886642D-01	0.02112	5.353
SD11	0.2602763D+00	0.06421	16.433
SD9	0.2369805D+00	0.06281	14.236
SD8	0.2453041D+00	0.06682	13.477
SD12	0.2530747D+00	0.07537	11.274
SD7	0.2095575D+00	0.06916	9.181
DMBE	-0.4321854D-01	0.03801	1.293
(Constant)	0.3555547D+01		

---------- Variables not in the equation ----------

Variable	F
BM	0.626
HDENS	0.037
MWTR	0.543
DCRS	0.466
DBS	0.901
DFMJ	0.150
DRJ	0.009
DHE	0.388
DND	0.379

Analysis of variance	Df	Sum of squares	Mean square	F
Regression	35.	7.91909	0.22626	15.29811
Residual	211.	3.12070	0.01479	

Multiple R	0.84695
R square	0.71732
Adjusted R square	0.67043
Standard error	0.12161